BDCP Effects Issue Brief

Topic: Effects of changes in delta outflow on delta smelt

Authors: Department of Interior biologists

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Summary of position.

Substantial reductions in delta outflow in the BDCP proposed project have not been adequately evaluated in the Effects Analysis and are likely to increase the risk that delta smelt will become extinct. Analysis of these changes should be completed in order to fully characterize the problem, but it appears to be important enough to warrant reconsideration of the delta outflow features of the proposed project.

Introduction.

The BDCP modeling output indicates that there will be a substantial decrease in delta outflow in certain scenarios, accompanied by substantial reductions in outflow variability. Discussion of these changes in "theme team" meetings have produced expressions of concern by some participants that the changes could adversely affect several covered species, including Winter-Run Chinook salmon, delta smelt, and longfin smelt. This brief addresses only the delta smelt aspect of the issue.

Outflow effects on delta smelt, in particular, were the subject of an all-day "theme team" discussion on 9/23. While there appeared to be agreement that additional analytical work is needed in this area, there was considerable controversy over the interpretation of the relevant model data and the application of the available scientific literature to this issue.

At the end of that meeting, it was agreed that an "unresolved scientific controversy" exists that pertains to the effects of delta outflow reduction on delta smelt. It was further agreed that the opposing sides in the controversy would prepare BRIEF summaries of their positions for review by the Oversight Committee and others. The summaries are intended to (a) clearly define a position on the conclusions that can reasonably be drawn from the available data; (b) provide the train of logic by which the conclusions were arrived at, and references to the supporting evidence; and (c) a statement of the importance of the issue to the success of the BDCP.

This summary by the Interior biologists is meant to frame the position that the outflow reductions revealed in the proposed project CALSIMII modeling indicate that the project as described would substantially adversely affect delta smelt in the future. While the authors view the current Effects Analysis as incomplete (and, in particular, not incisive enough in the way it addresses this issue), they believe the modeling results clearly indicate that adverse affects would likely occur. Hence, this is not a case of simple uncertainty about the science.

The Position, Step by Step

1. The low-salinity zone (LSZ) is an important physical characteristic of the San Francisco Estuary, and it has important biological concomitants.

The LSZ is the interface between the freshwater and marine environments and ranges in salinity from about 0.5-6 psu (Kimmerer 2004). The LSZ changes in position, size and shape primarily in response to tides and delta outflow. The metric X2 was developed to index the relative location and extent of the LSZ (Jassby et al. 1995). Monthly delta outflow and X2 data are the factors available within the BDCP modeling framework to evaluate project effects to the LSZ.

It is well established that variation in Delta outflow or X2 is correlated with many ecosystem processes and the abundance or survival of estuarine biota (Stevens and Miller 1983; Jassby et al. 1995; Kimmerer 2002; Kimmerer 2004; Kimmerer 2009; Thomson et al. 2010; Mac Nally et al. 2010; Feyrer et al. 2010). Because the LSZ is dynamic in both space and time, habitat conservation and restoration efforts involving species that use the LSZ must address the dynamism. In the BDCP, restored habitats will be inhabited by LSZ species (e.g., delta smelt) only when delta outflow causes the LSZ to overlay the nominal habitats or occur in areas accessible from the habitats.

2. The LSZ is crucial habitat for delta smelt.

Of all the species covered under the BDCP, delta smelt spend the largest fraction of their life cycle in the low-salinity portion of the estuary. Except during spawning, pre-adult and adult delta smelt live their entire lives in the LSZ (Moyle et al. 1992; Bennett 2005; Feyrer et al. 2007; Nobriga et al. 2008) with a center of distribution closely associated with X2 (Bennett 2005; Sommer et al. 2010); juvenile delta smelt are consistently distributed slightly upstream of X2 (Dege and Brown 2004). As a result, X2 strongly predicts delta smelt distribution, as well as the location and amount of suitable abiotic habitat (Feyrer et al. 2010).

3. BDCP will substantially affect the LSZ from early summer through early winter.

As indexed by X2, the BDCP modeling output suggests that the proposed project will affect the LSZ in several ways. The project will cause X2 to shift substantially upstream from June through December in wet and dry years, from May through December in above normal and below normal years, and from September through December in critical years. Intra-annual variability will be lost in the fall months in all water year types; X2 will become static. Interannual variability will be lost in the fall months among water year types; wet years will become dry years. The magnitude of these effects is illustrated in the box plots that follow the text.

4. The effects of water temperature are not adequately addressed in the effects analysis.

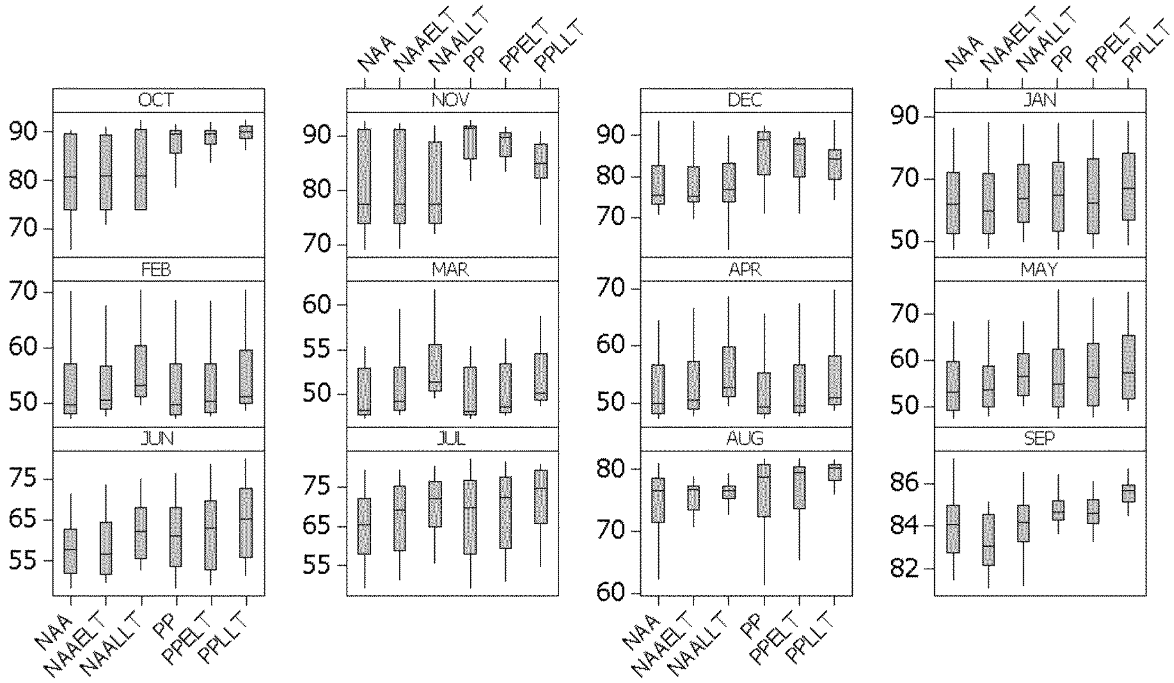
Central California is projected to get warmer in the coming decades (Dettinger 2005). This aspect of climate change and its consequences are not adequately addressed in the effects analysis. Although this is not a project effect, it does have serious implications for the proposed project because at its upstream edges, the LSZ is already seasonally too warm to support coldwater fishes. Warmer water in the future will exacerbate this fundamental physiological limitation - particularly for the salmonids and smelts. Delta smelt is the species of highest concern because it is not anadromous and therefore cannot avoid excessively warm LSZ waters by migrating elsewhere.

5. The effects of BDCP on the LSZ and interactions with future climate change is likely to have serious consequences for delta smelt.

Because X2 is an index of delta smelt distribution and the position and amount of delta smelt abiotic habitat, changes in habitat distribution are directly associated with changes in X2. This has several implications for delta smelt. First, under the proposed project delta smelt habitat will very seldom coincide with Suisun Bay and Marsh. Thus, it is unlikely that restored tidal marsh in the Suisun region, or even existing Suisun tidal marsh, will meaningfully contribute to delta smelt recovery, and it may not contribute to production. Second, lower summer outflows will increase the length of time that seasonal delta smelt habitat constriction occurs and overlaps with physiologically stressful water temperatures. This means that more food production will be required to maintain current delta smelt growth and survival rates, even in areas where temperatures remain suitable. In areas where temperatures exceed physiological suitability limits (~24 C) during the summer, no amount of food production will increase growth rates or survival rates. Third, the restricted distribution of delta smelt during most summers and essentially all falls will increase the chance that a localized catastrophic event, such as a chemical spill, would pose a serious threat to the continued existence of delta smelt. Fourth, the effects of lower outflow and increased residence time in combination with warmer water temperatures are likely to push the lower Sacramento River and the west Delta towards a submerged aquatic vegetation, *Microcystis* and centrarchid-dominated community similar to that which currently exists in the lower San Joaquin River and south Delta.

6. The draft effects analysis does not have a complete and balanced assessment of the target species habitat requirements. Delta outflow, chemical conditions and the food web are interrelated and influence fish abundance in the estuary (Kimmerer 2002; Rosenfield and Baxter 2007; Sommer et al. 2007; Kimmerer et al. 2009; Thompson et al. 2010; Mac Nally et al. 2010). Several recent studies have shown that even the relatively abundant animals that use the LSZ are food-limited and exposed to contaminants. This includes splittail (Greenfield et al. 2008), Mississippi silversides (Lehman et al. 2010) and even overbite clam (Thompson et al. 2006) and largemouth bass (Nobriga 2009). Because silversides, the overbite clam, and largemouth bass are thriving, it is clear that the effects of 'other stressors' cannot by themselves explain ecological success or failure. The effects analysis does not have any scientifically defensible demonstrations that the outflow regime in the proposed project will reduce the effects of "other stressors" such as contaminants, eutrophication, non-native predators, and submerged aquatic vegetation. In fact, because delta outflow will be reduced, the importance of these "other stressors" to native fish species may be increased (because of increased temperatures and residence time, decreased current velocities, etc.). Therefore, overall habitat conditions under the proposed project are likely to be worse than present day conditions or future conditions under the "no action alternative".

X2 - Wet Years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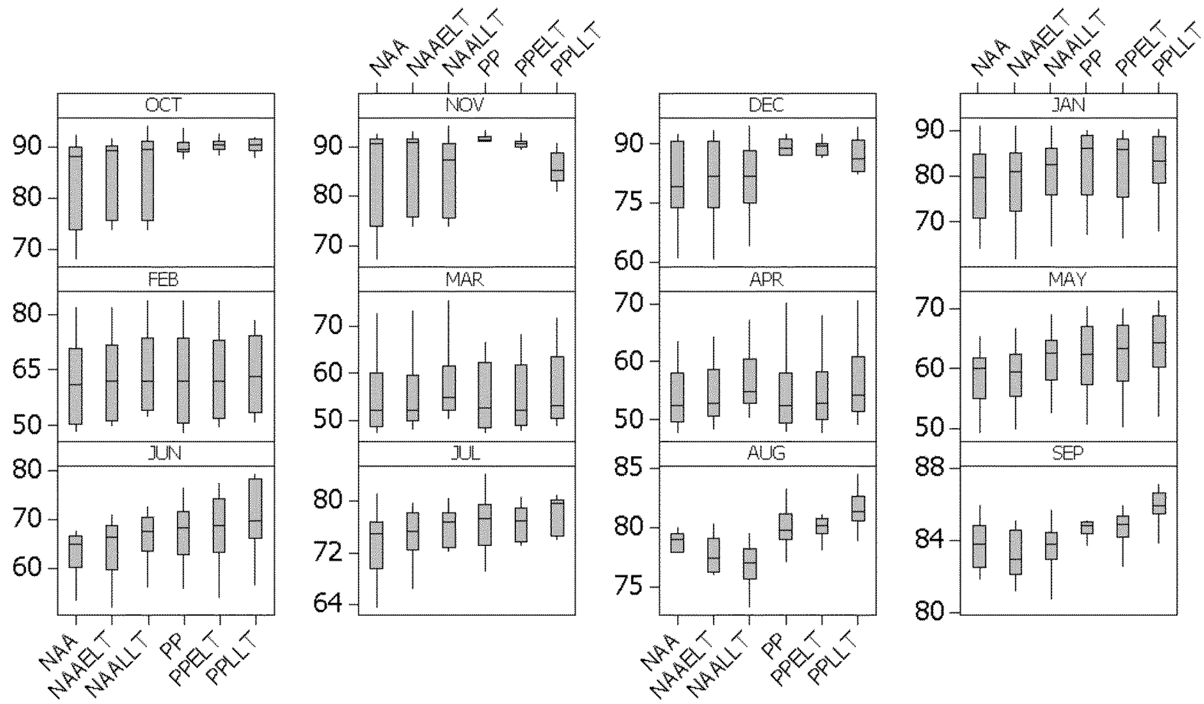
X2 - Above Normal Years



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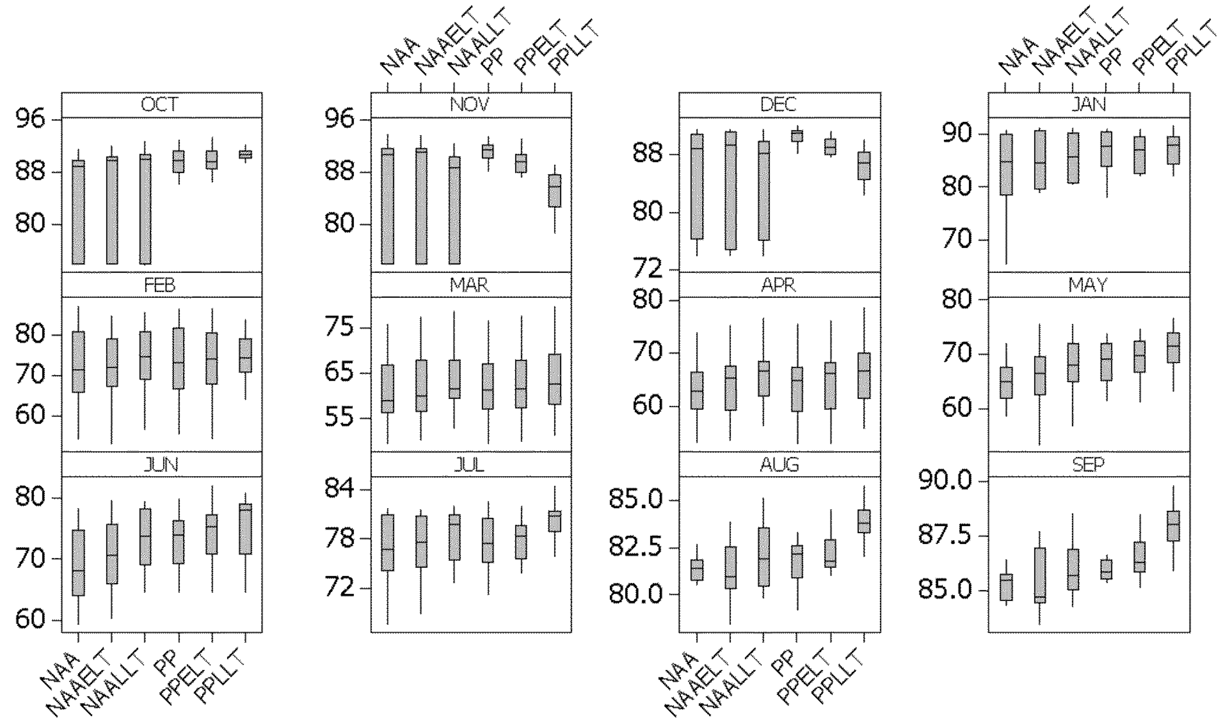
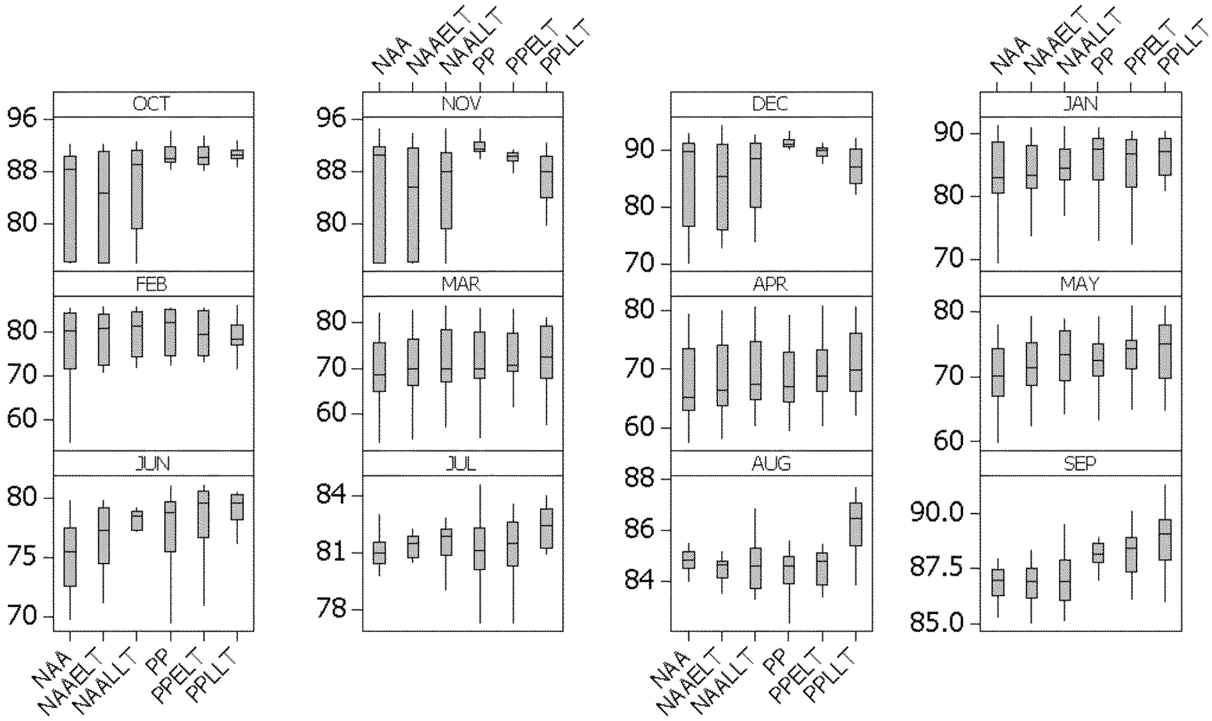
X2 - Below Normal Years



X2 - Dry Years



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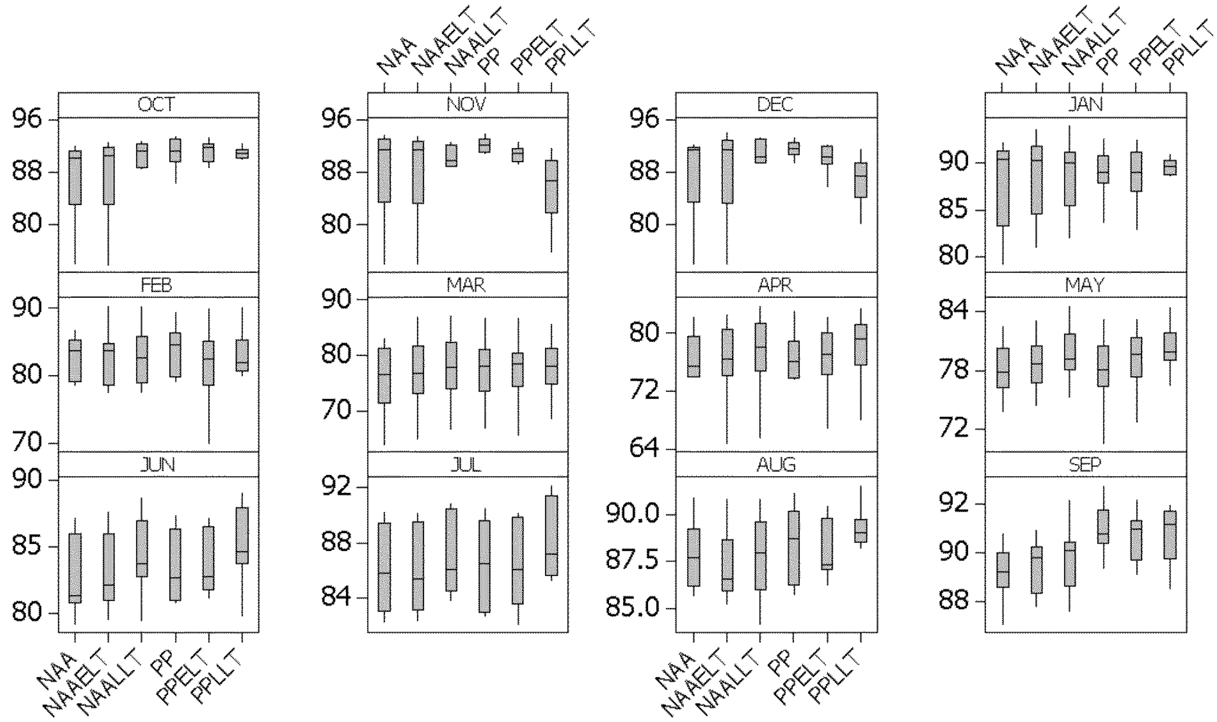
X2 - Critical Years



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